Nontornadic Convective Wind Fatalities in the United States: 1977-2007

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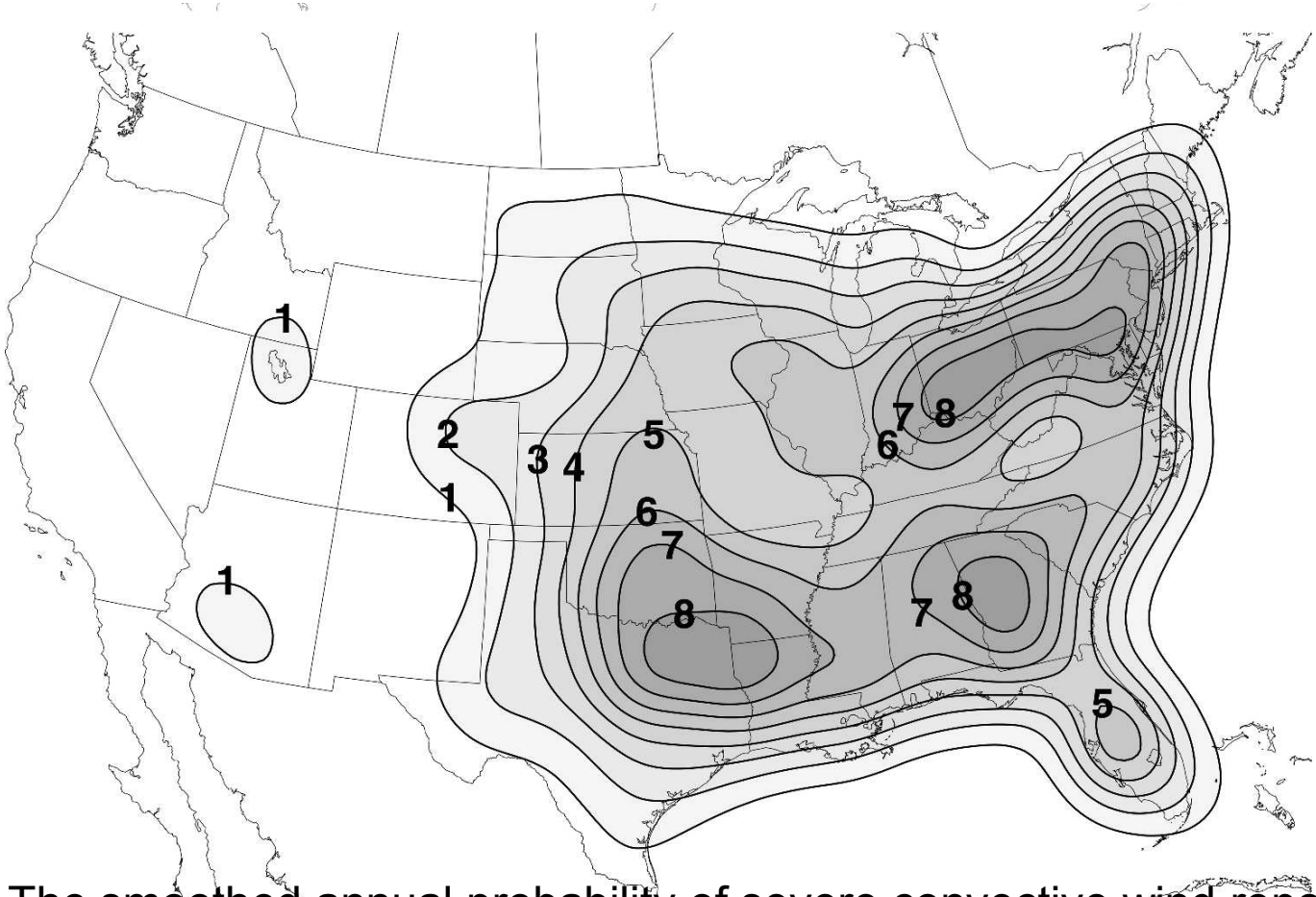
Introduction

- Severe Windstorms are responsible for many fatalities each year in the U.S.

- Studies have examined deaths associated with:
  - Tornadoes (e.g., Galway 1975; Brown et al. 2002; Brooks and Doswell 2002, Ashley 2008)
  - Hurricanes (Rappaport 2000)
  - Nonconvective Wind (Ashley and Black 2008)

- Information is rather sparse for nontornadic convective windstorms, especially in terms of human impacts.

Climatology

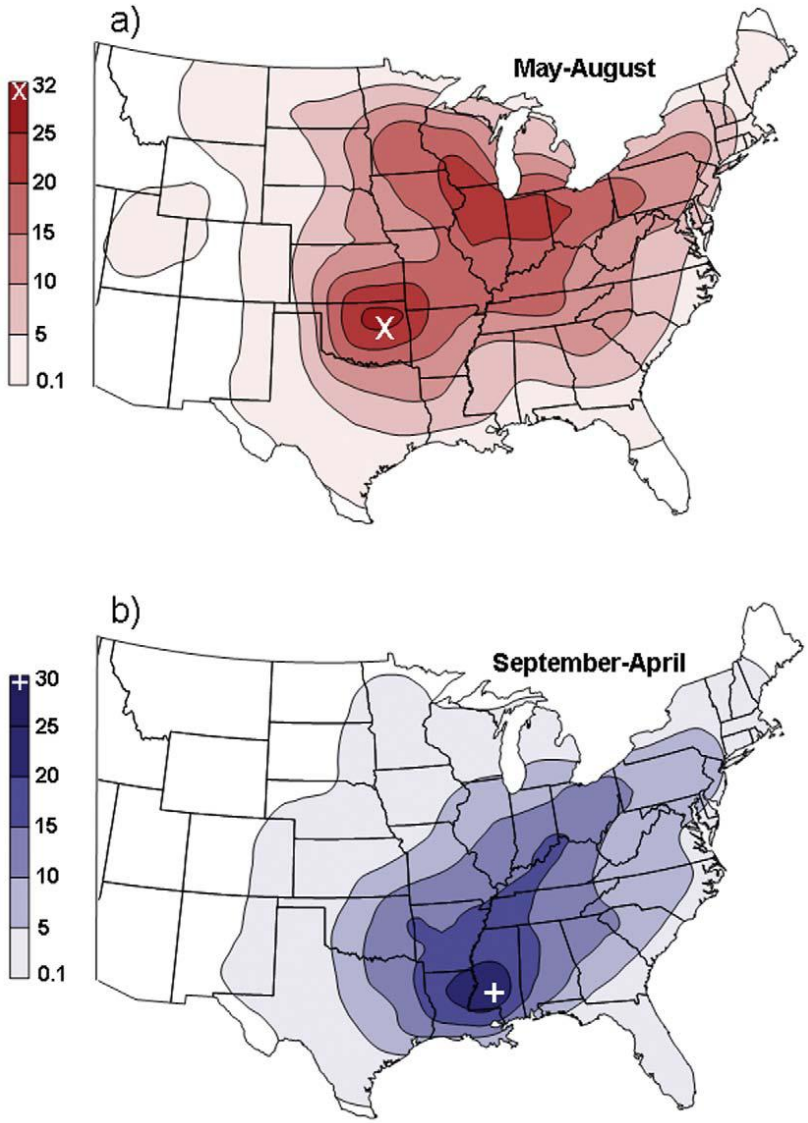


- Nontornadic convective wind most common across South, Southeast and Ohio Valley in the warm season months of June, July, and August.

The smoothed annual probability of severe convective wind reports (winds ≥ 25m s −1). Probability contour values in percent, starting at 1.0%. (from Doswell et al. [2005]).

Derechos

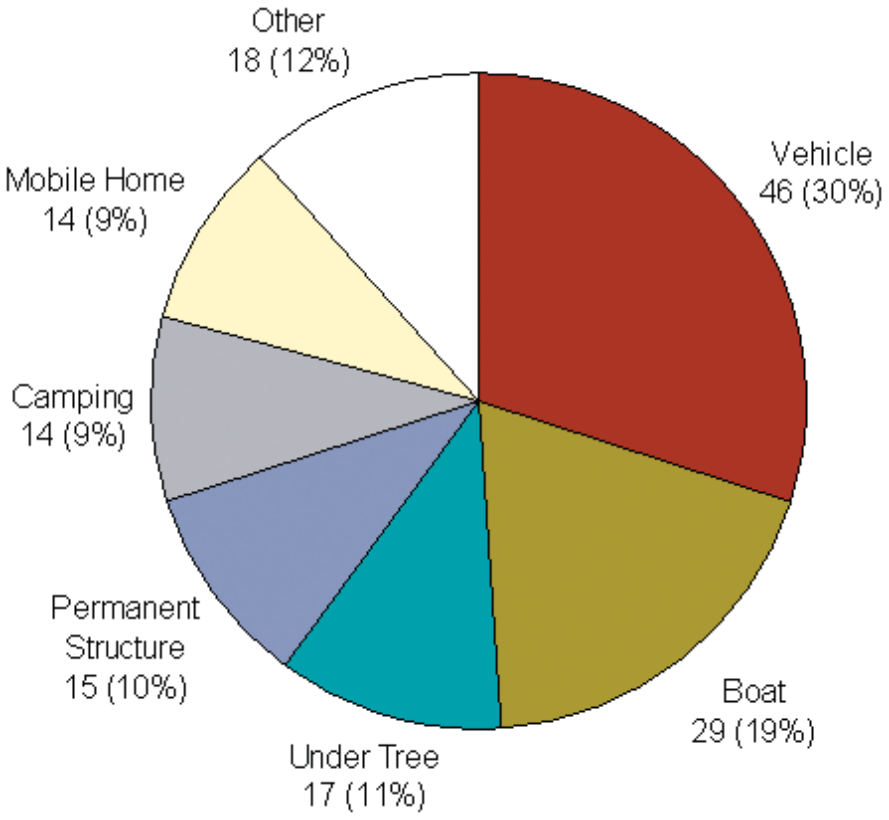
- Ashley and Mote (2005) examined the climatology and fatalities associated with long-lived convective windstorms known as "derechos"
- Seasonal variation in location of frequent occurrence.



Derecho Fatalities

- Derecho fatalities most common in Michigan, Ohio, and New York – outside the area of highest occurrence.

Derecho Fatalities



- Most fatalities occur in vehicles, while boating or outdoors.
- However, derecho fatalities only accounted for 38.8% of nontornadic convective wind fatalities from 1993-2003 (Ashley and Mote, 2005).

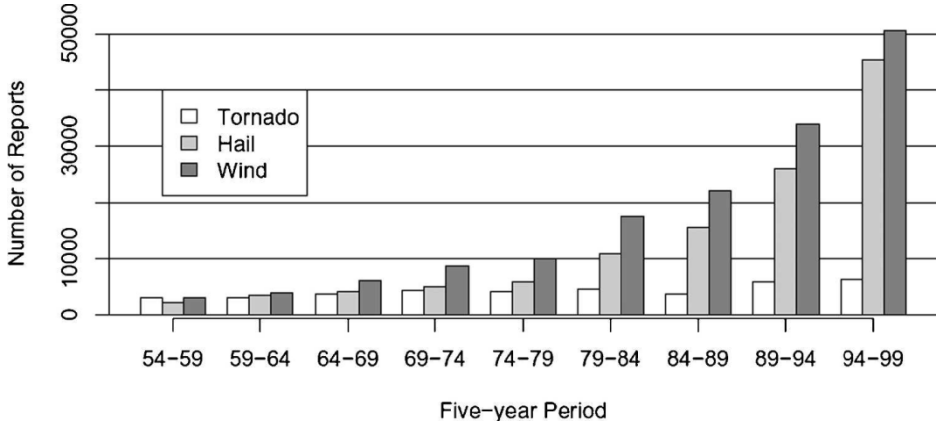
Research Questions

- What are the spatial and temporal distributions of the rest of these nontornadic convective wind fatalities?
- How does the fatality distribution compare to the climatology of nontornadic convective wind?
- How do these distributions compare to other wind hazards such as tornadoes and non-convective wind?
- How does the subset of derechos compare to the entire set of nontornadic convective wind?

Data

- Fatalities – 1977-2007
  - From NCDC's *Storm Data*
    - Fatality numbers from *Storm Data* must be approached with caution due to difficulty in collection of these data.
  - Generally includes Date, Time, Geographic Location, "Place", and description of event.

Storm Data Problems



The time history of the number of hail, wind, and tornado reports for the eight 5-yr periods from 1955 to 1994. Note the apparent change in the trend beginning with the period 1979–84. (Doswell et al. 2005)

- Increasing quantity of reports.
  - Increasing quantity of events?
- Only 12.4% of killer nontornadic convective wind events involve more than 1 person
  - Receive less attention?
  - Likely under-reported as a result (Curran et al. 2000)
  - Difficult to test this hypothesis.

Data

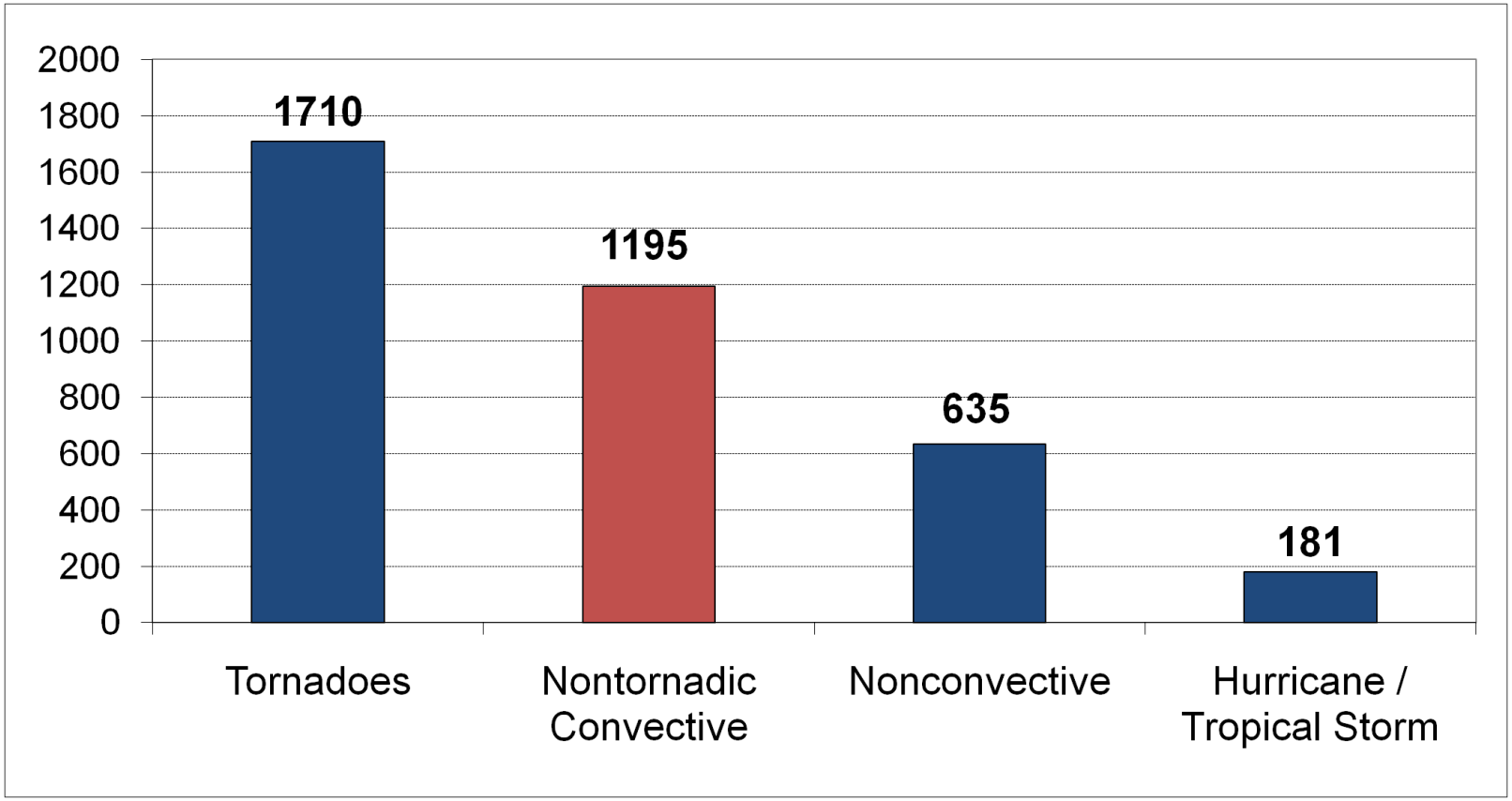
- NTSB Aviation Accident Database
  - Initial examination of *Storm Data* revealed only 29 aircraft related fatalities.
    - High fatality events such as 9 July 1982 crash of Pan Am Flight 759 in New Orleans, LA and 2 August 1985 crash of Delta Flight 191 in Dallas, TX missing from *Storm Data.*
  - Aircraft related nontornadic convective wind fatalities identified by reading narrative description of incident.

Methodology

- A geographic information system (GIS) was used to reveal the spatial patterns of these fatality data.
  - Latitude and longitude information for the location of each fatality was collected.
  - Fatalities were mapped on an 80km x 80km grid; a grid of this size encloses the same area as a circle with radius 24.6 n mi, which is similar to the area under consideration by SPC forecasts (Doswell et al. 2005).

- The climatology of nontornadic convective wind was compared to nontornadic wind events and to fatalities from non-convective high winds and tornadoes to assess any regional similarities (or differences) that may exist in the spatial distribution of fatalities.

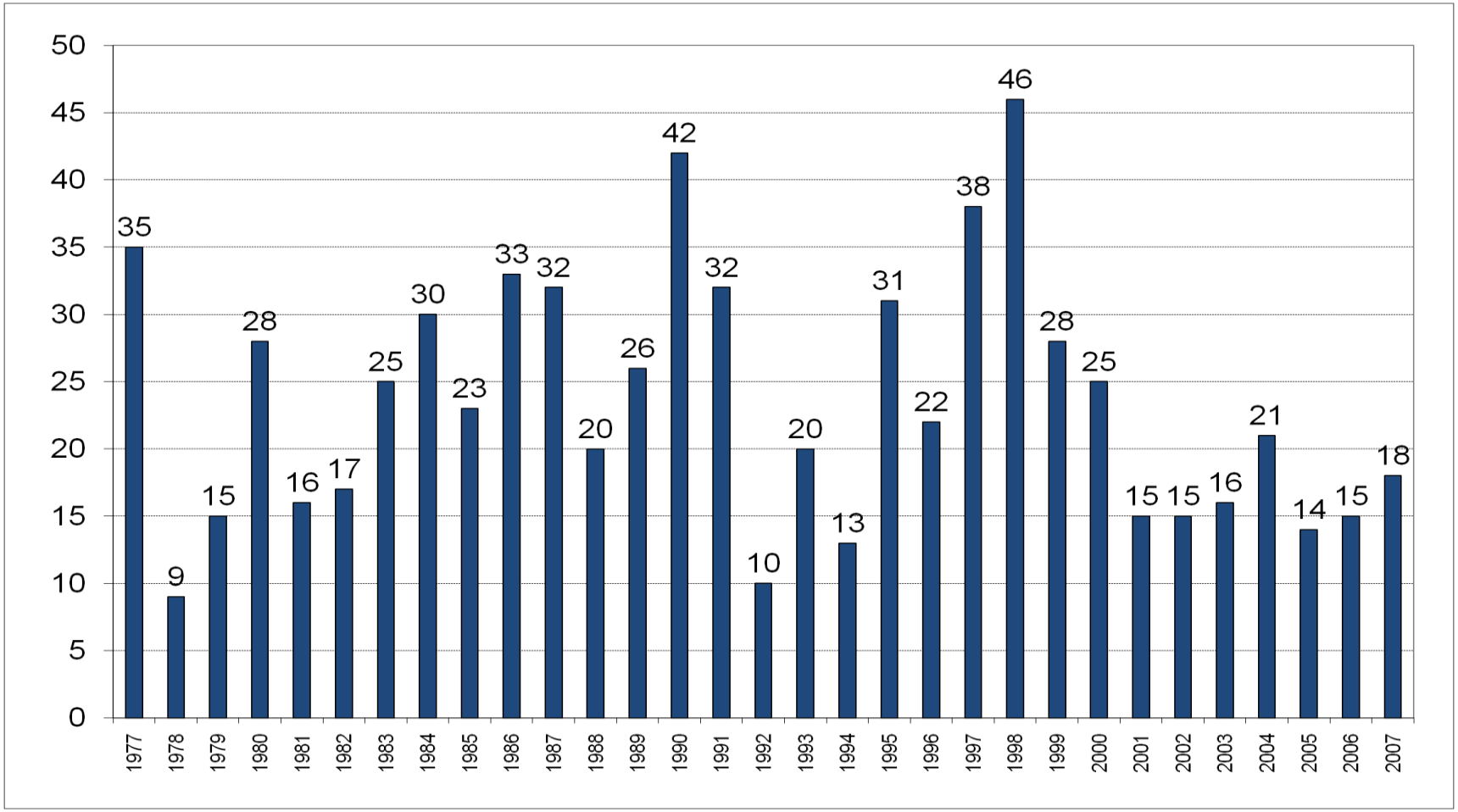
Results - Fatalities



Overall, Nontornadic convective winds responsible for 32.1% of wind fatalities during the 1977-2007 period (includes 465 aircraft related fatalities)

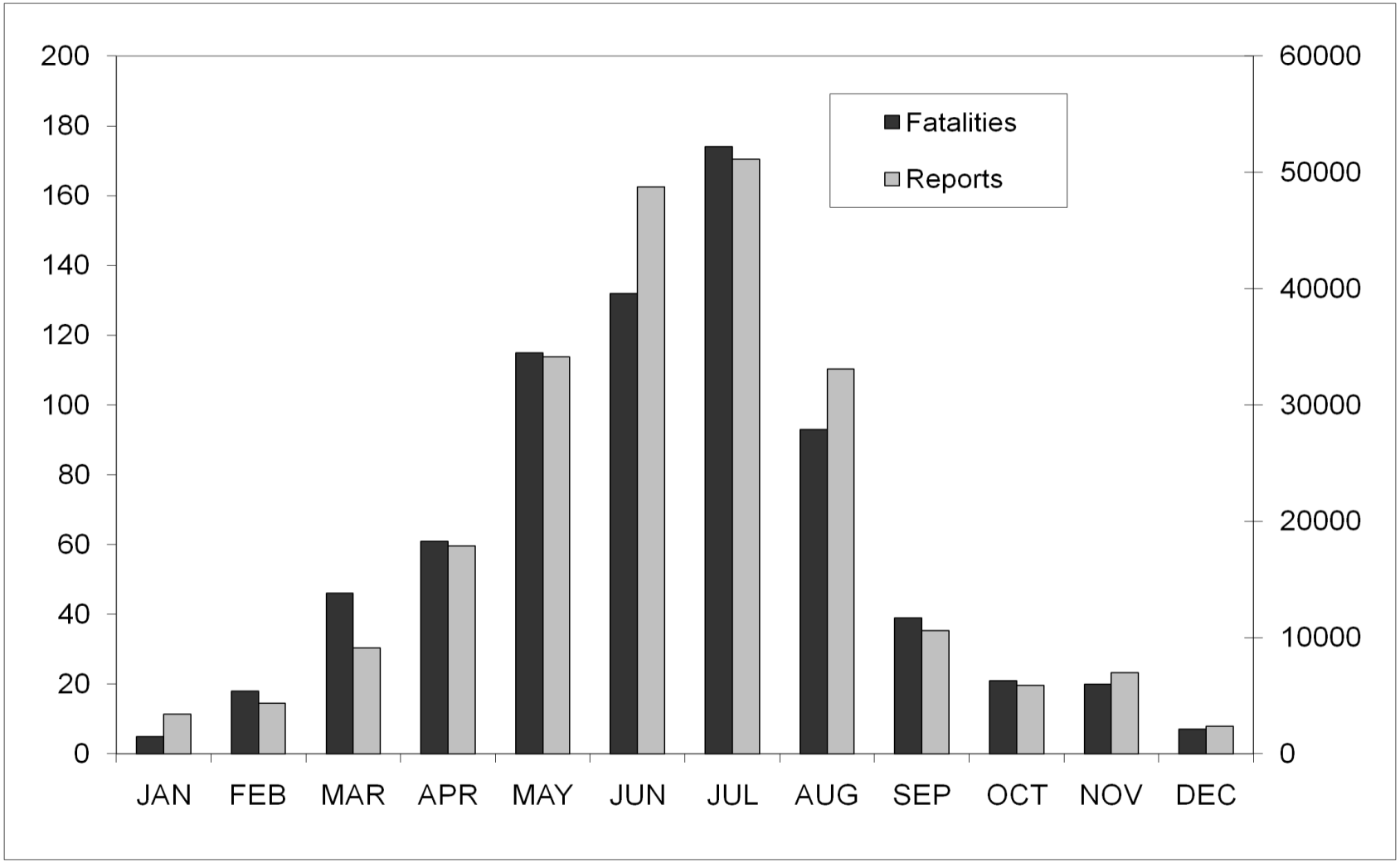
Nontornadic convective and Nonconvective combined account for 49% of fatalities, while tornadoes account for 46% of fatalities.

Fatalities by Year

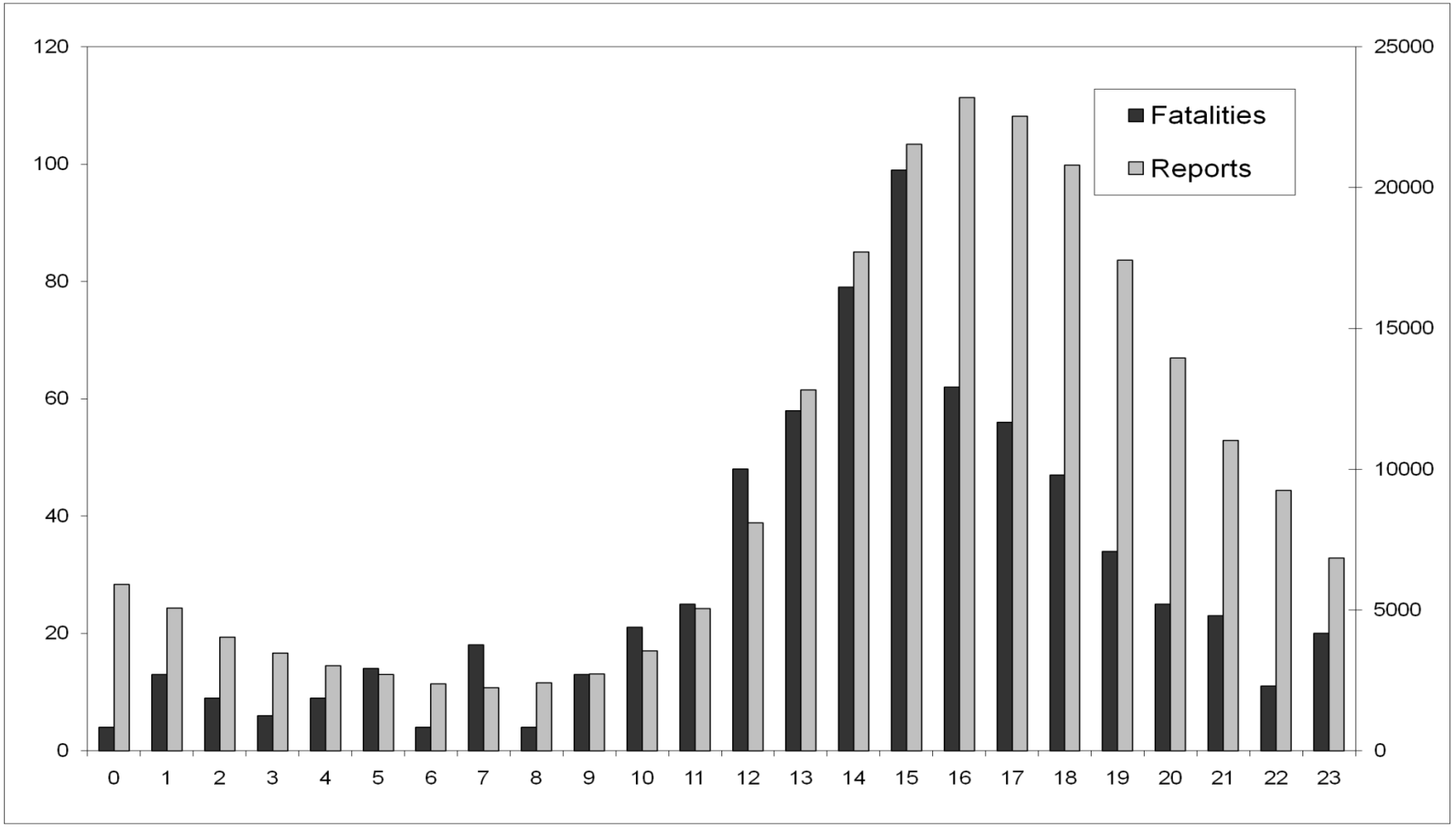


- On average, 31.7% of Nontornadic Convective Wind Fatalities for the years 1986-2005 due to derechos.

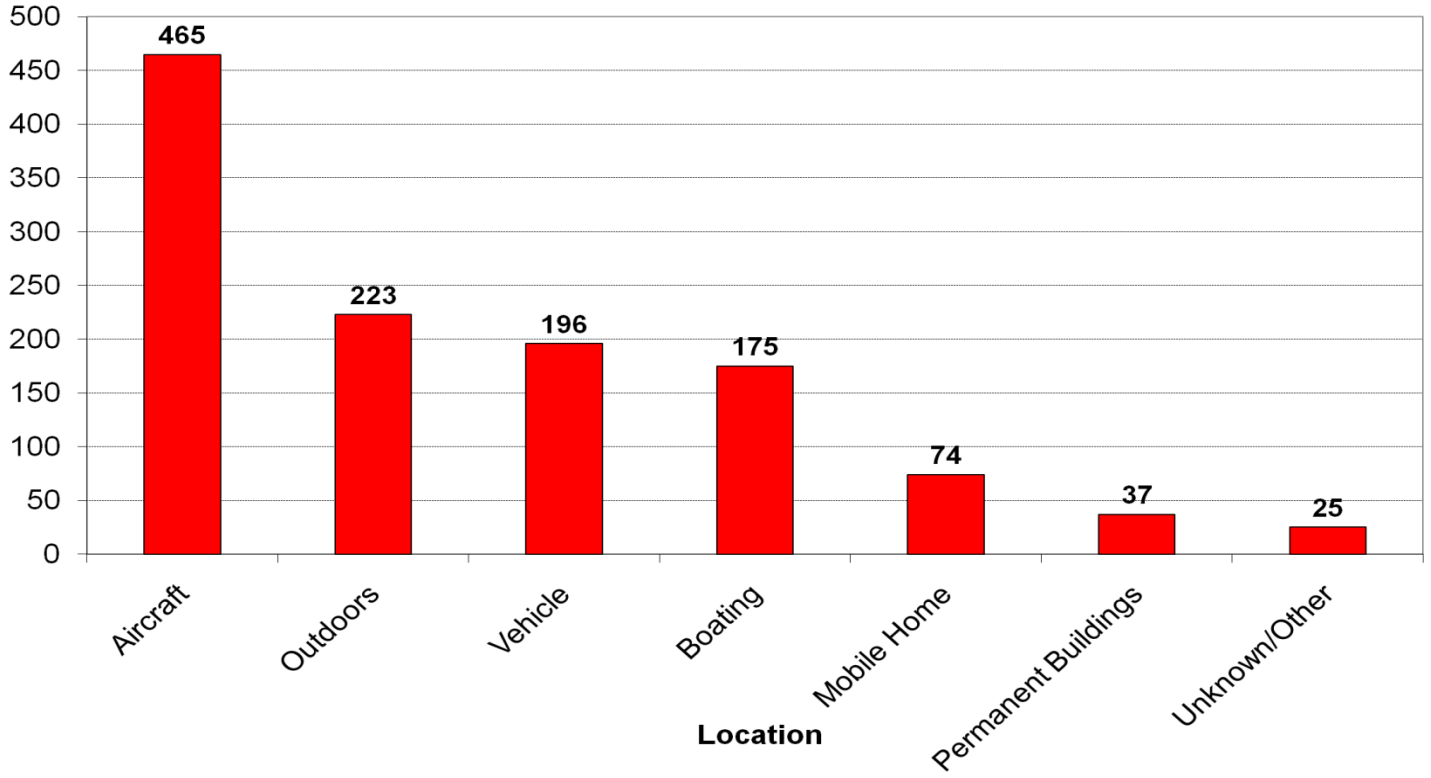
Fatalities by Month



Fatalities by Hour

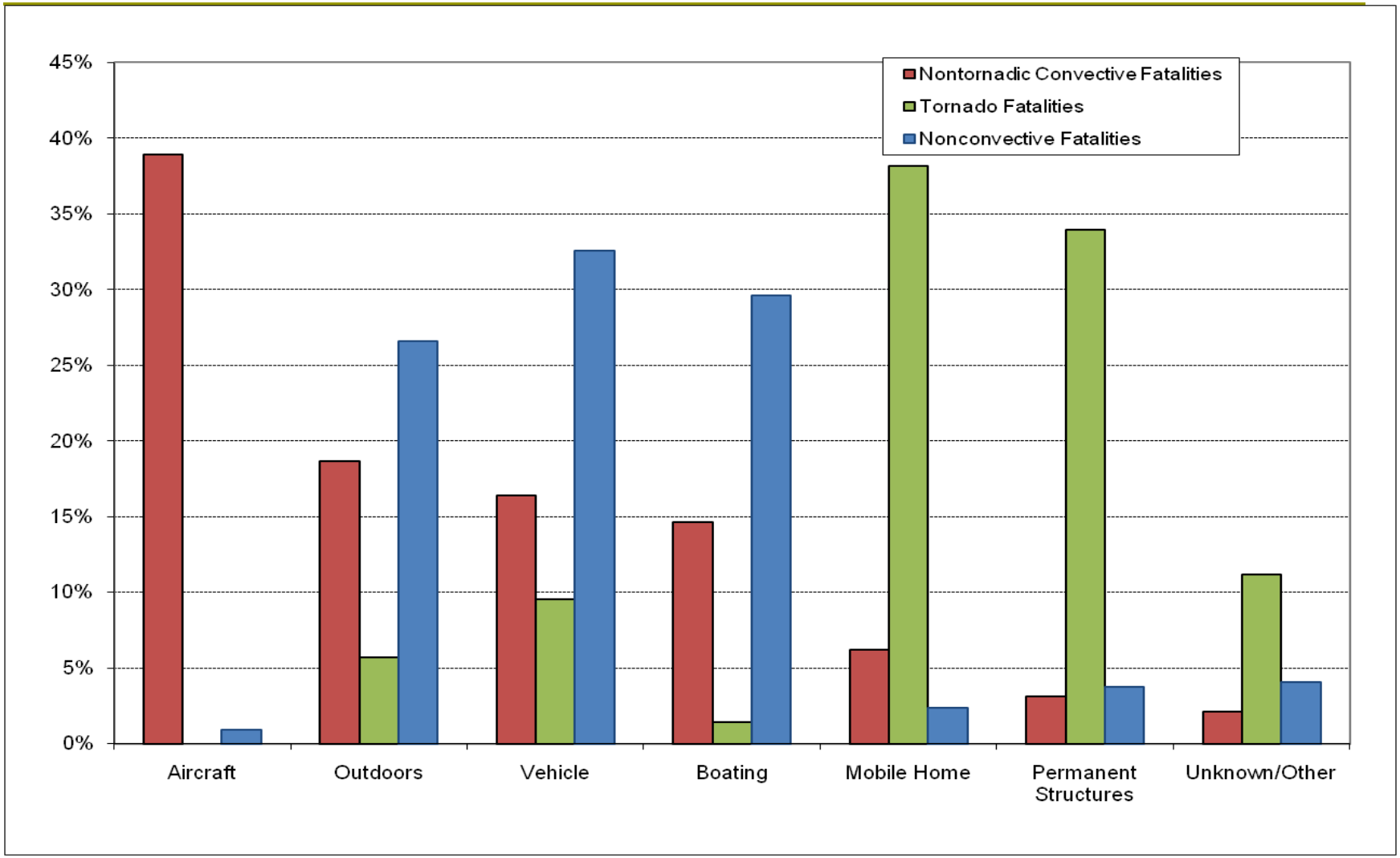


Fatalities by "Place"



- Most (88%) fatalities occur in aircraft, outdoors, in vehicles, or while boating.
- 42% of total fatalities were associated with a tree. Of tree related fatalities, 51% were vehicle related and 36% in other outdoor locations.

Comparison of Fatalities by "Place"



Aircraft Fatalities

- Several high fatality events such as the 9 July 1982 crash of Pan Am Flight 759 upon take off from New Orleans, LA and the crash of Delta Flight 191 during landing in Dallas, TX on 2 August 1985 were missing from *Storm Data*.

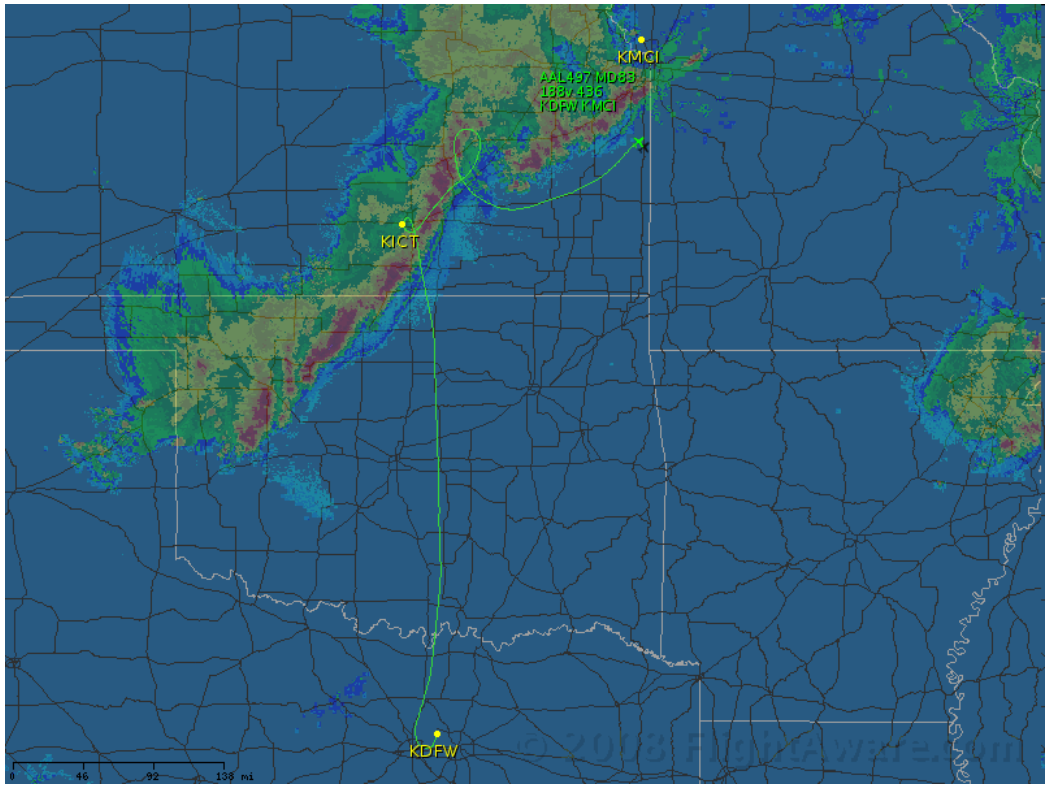
- Both of these accidents were the result of the aircraft encountering a convective microburst, and were responsible for 288 fatalities or 62% of aircraft-related nontornadic convective wind fatalities.

- At best, only 6% of aircraft related nontornadic convective wind fatalities were recorded in *Storm Data.*

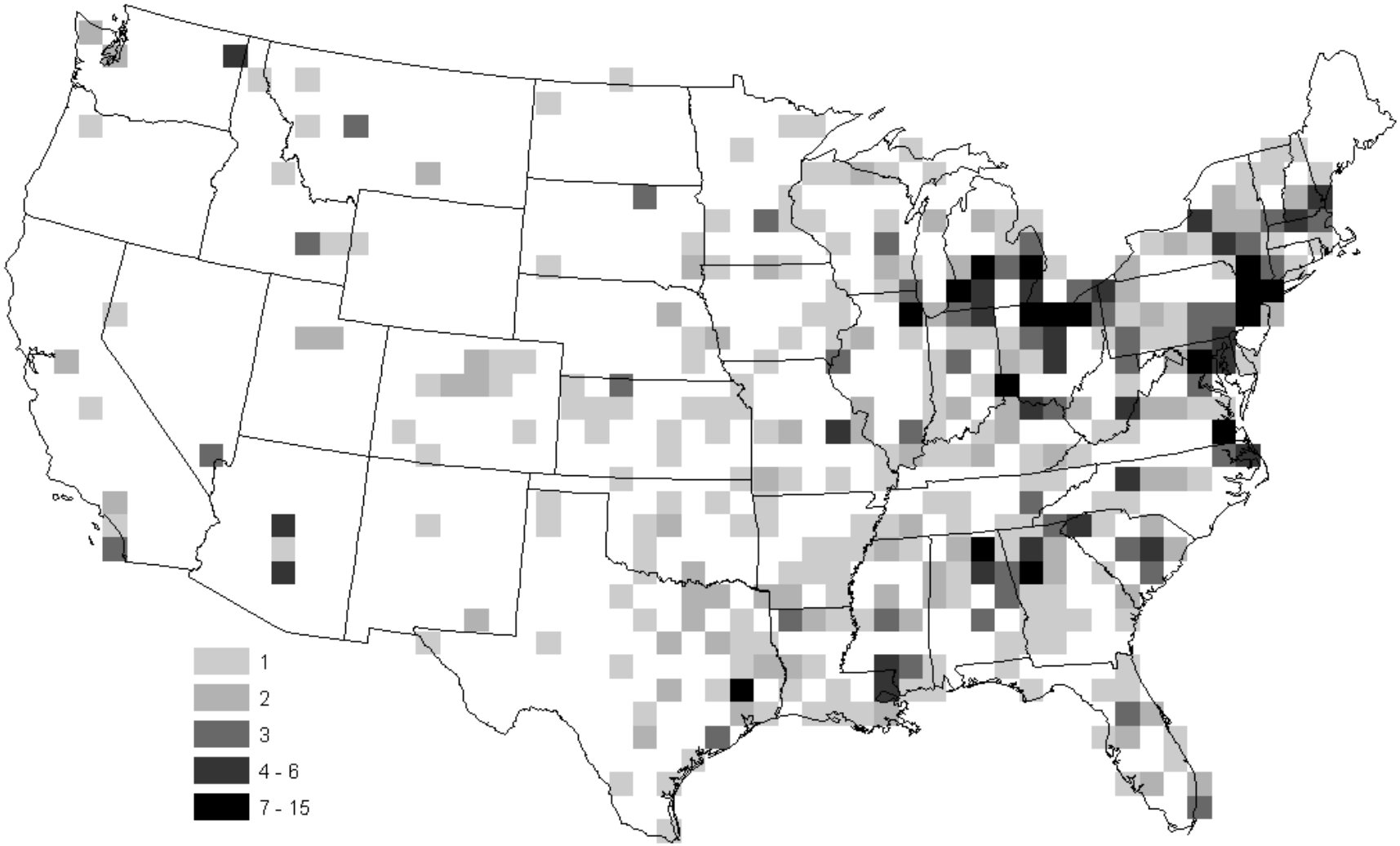
- This illustrates further the need for improvement in the methods used to gather damage and casualty information from weather-related hazards.

Aircraft Fatalities

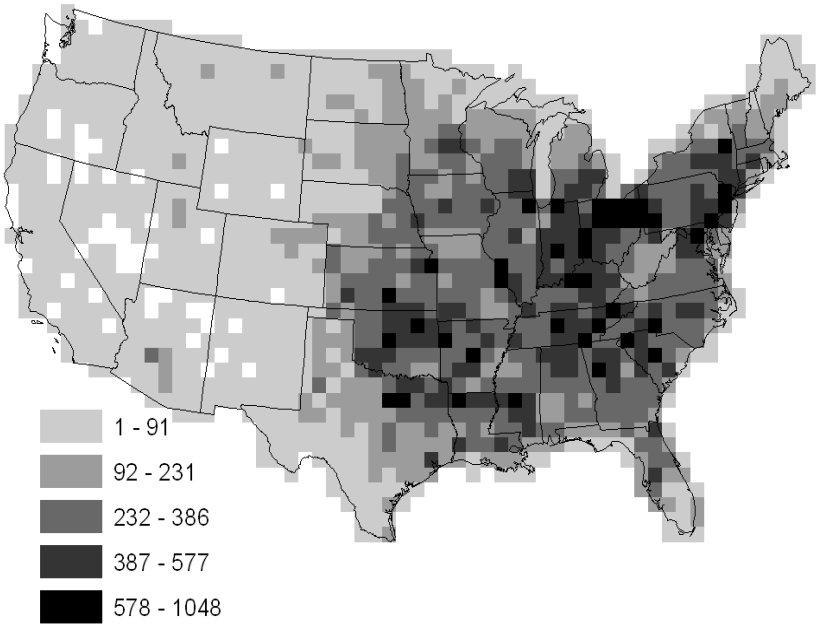
5/25/2008 – Wichita, KS

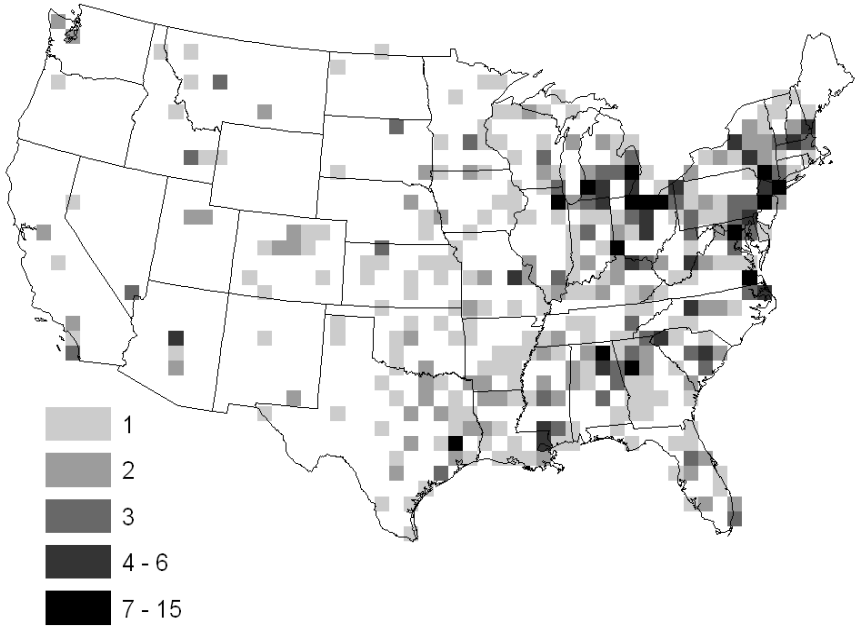


Killer Nontornadic Convective Wind Locations in an 80km x 80km grid 1977-2007

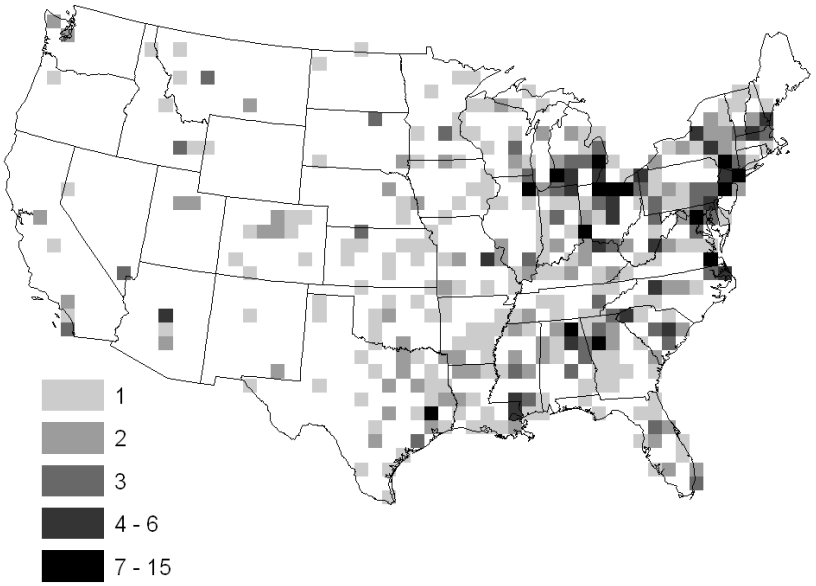


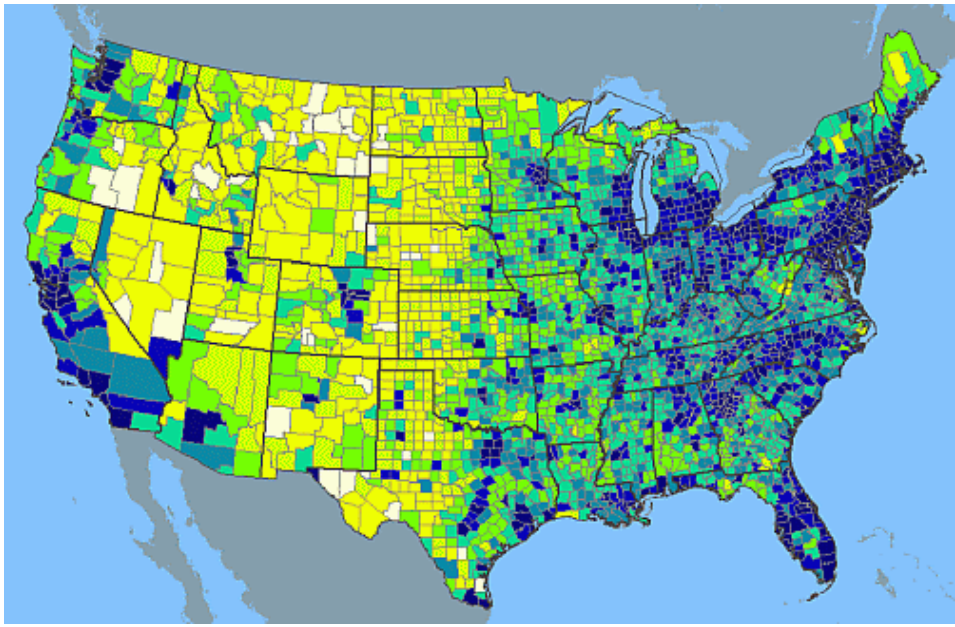
Climatology vs. Fatalities



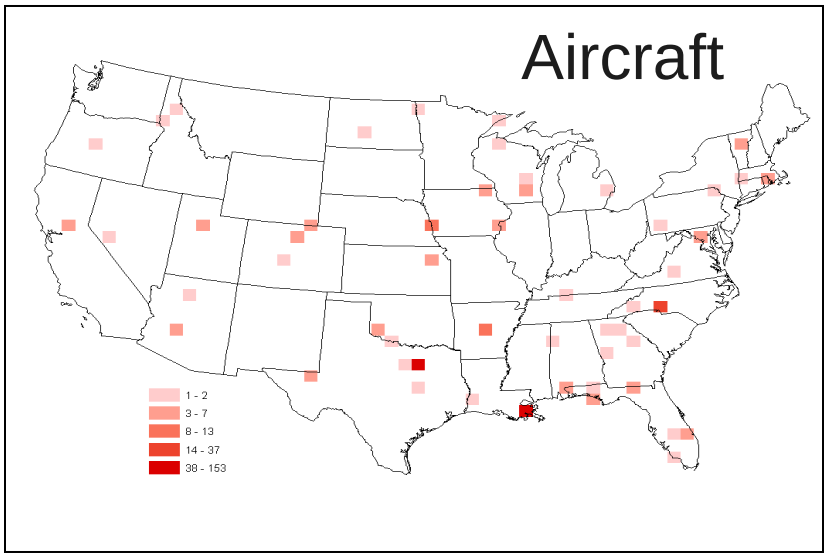


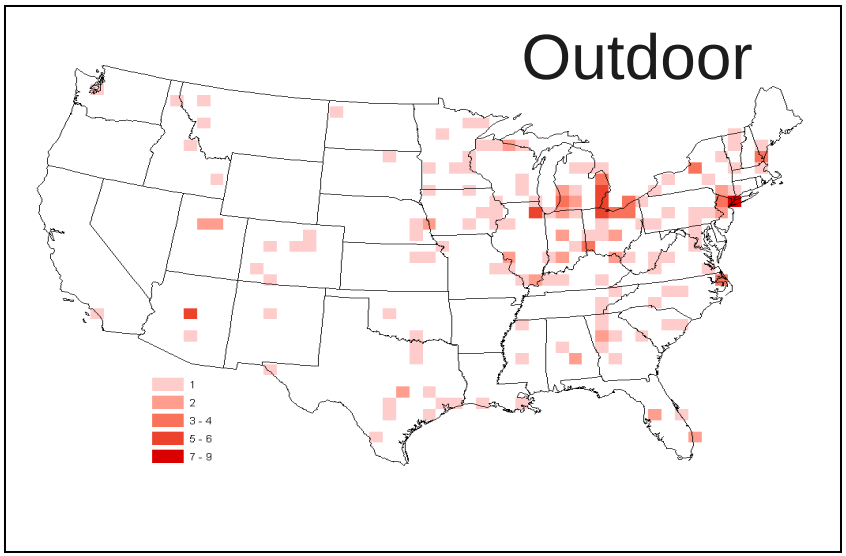
Fatality Locations vs. Pop. Density

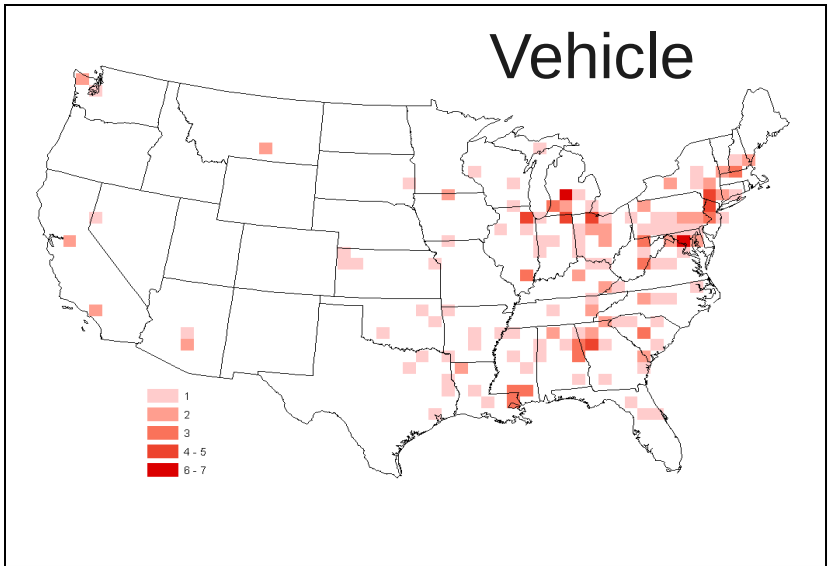


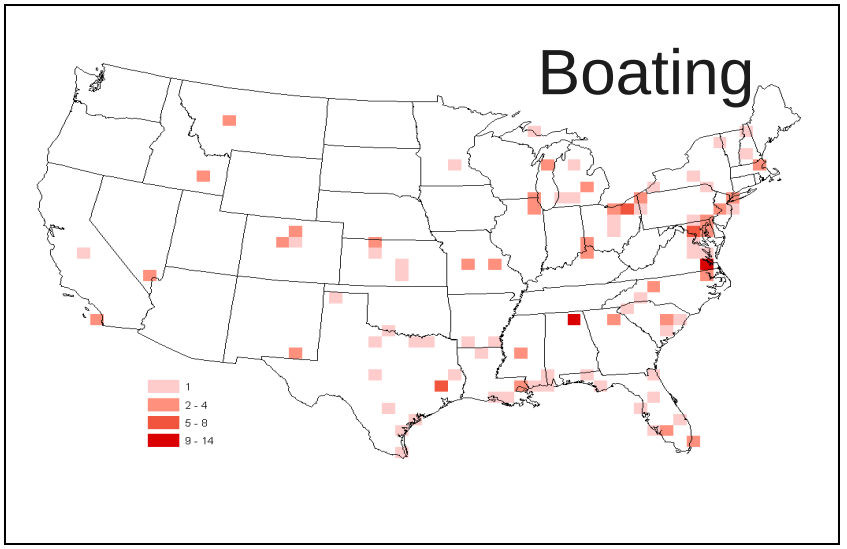


Spatial Examination of "Place"

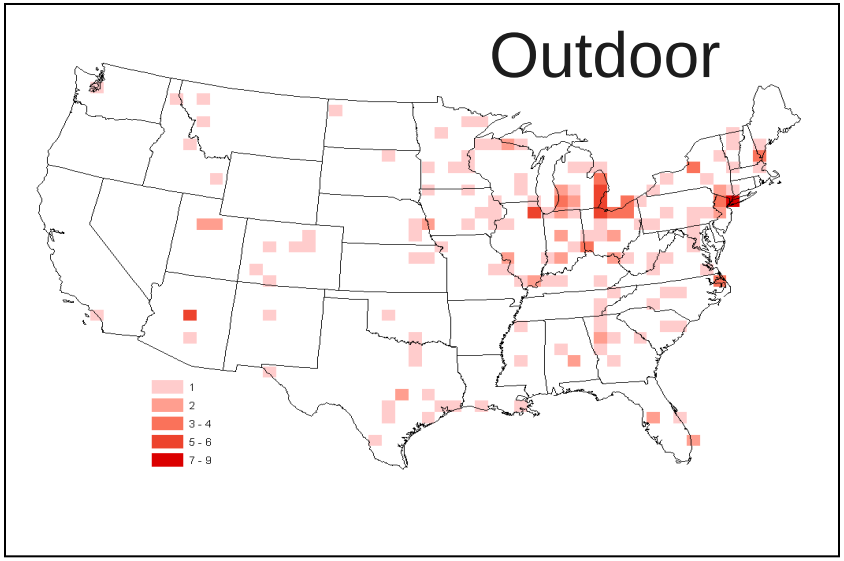


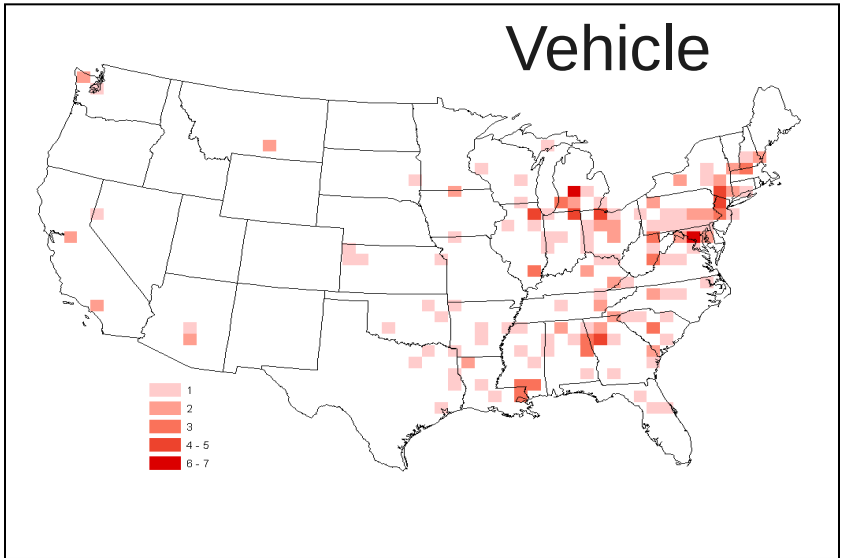


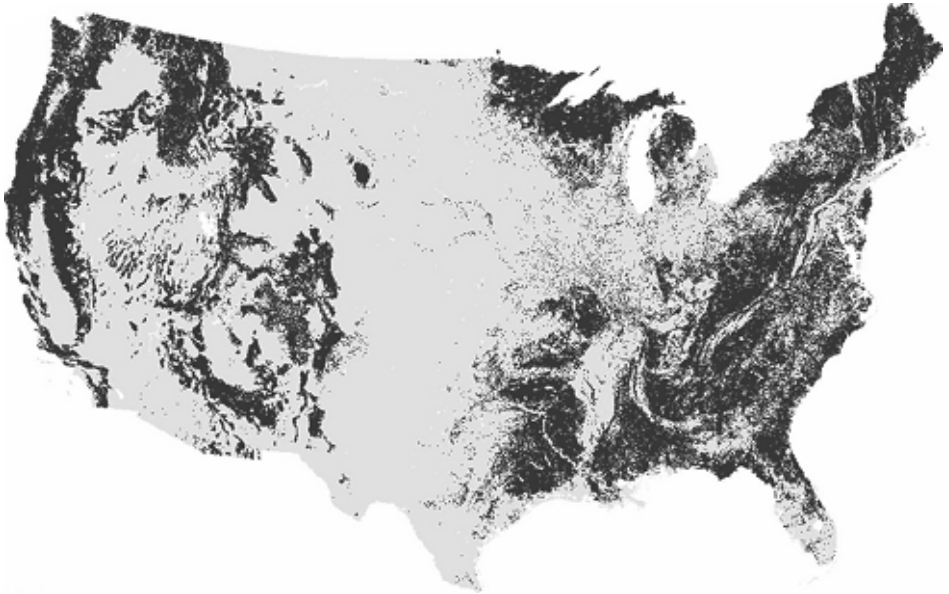




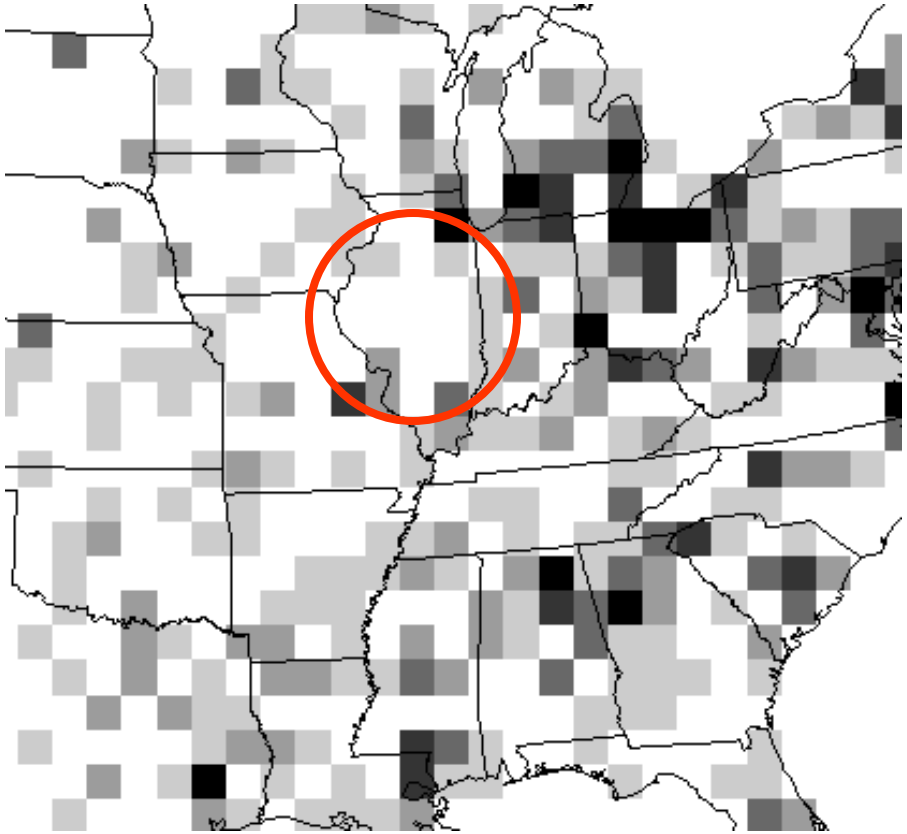
Fatality Locations vs. Forest Cover







Central Illinois?

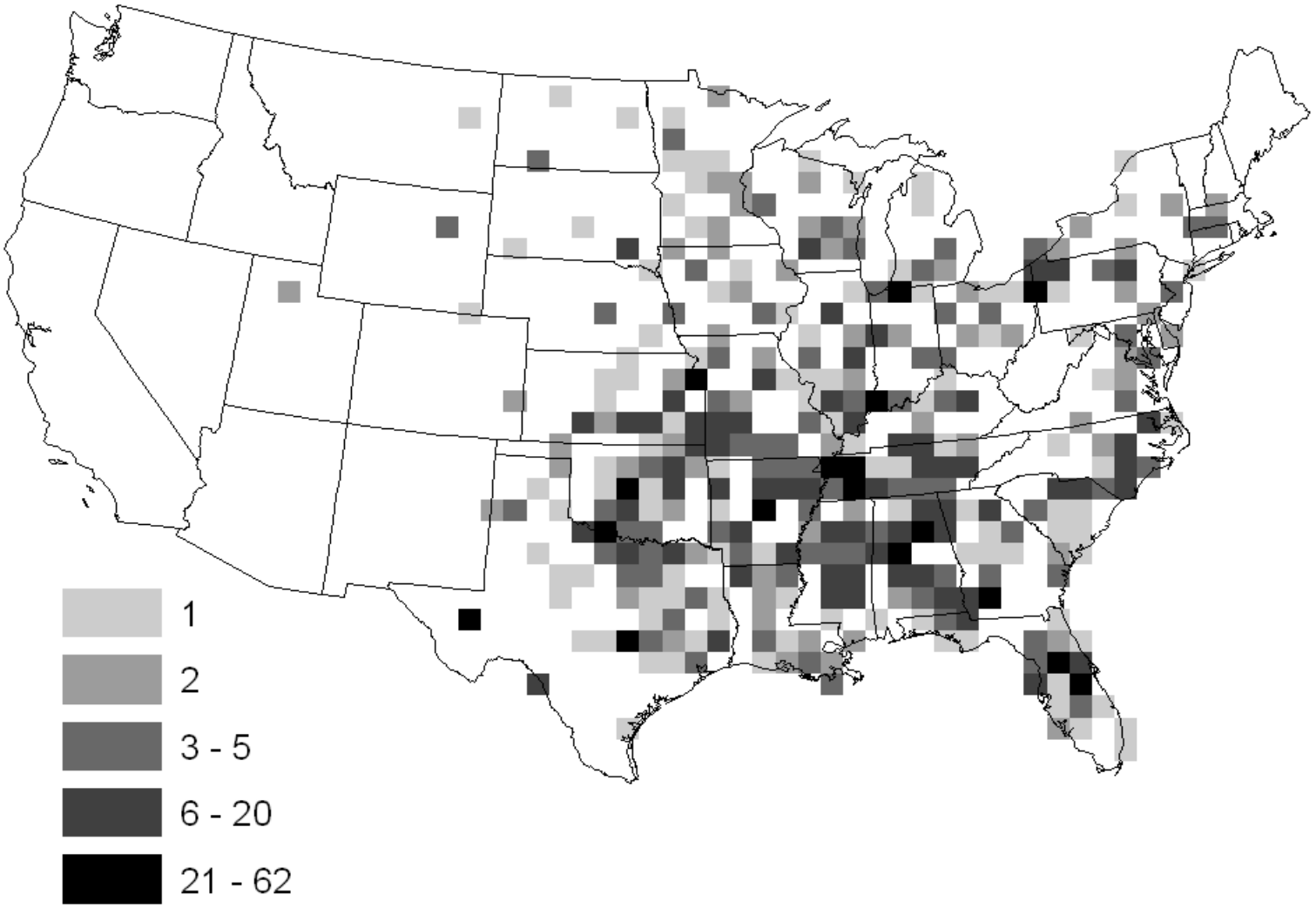


- No fatalities in Central IL 1977-2007.
- Why?
  - Areas of high population density
  - Numerous lakes/rivers
  - Some trees, especially in cities.
- It will happen!

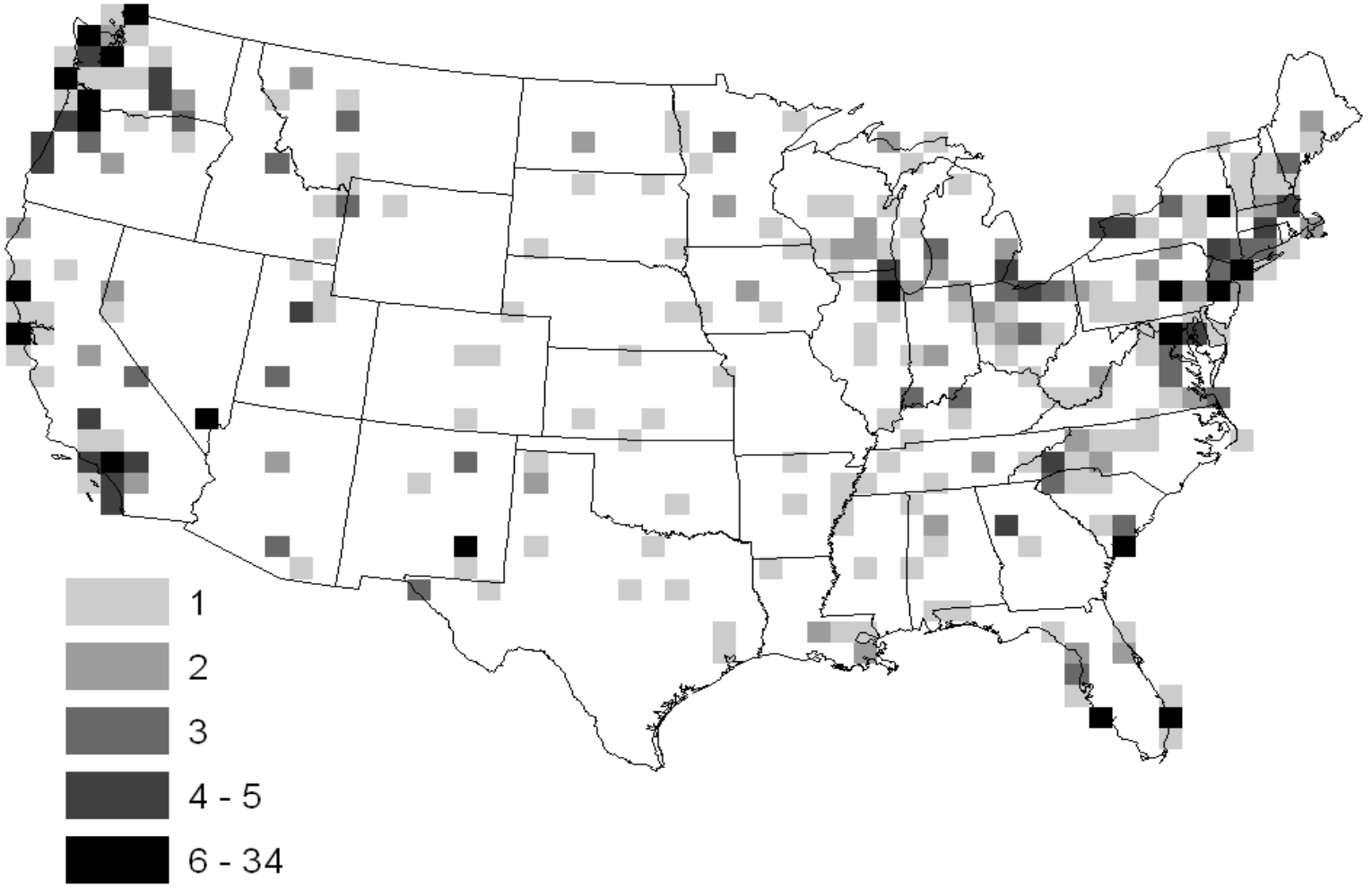
A Local Story – July 21, 2008

- "As the father of seven children rushed some to shelter during this morning's 90 mph winds, a tree fell on the tent where the rest were camping near Colona, killing a 4-year-old boy and critically injuring two other children." *- Moline Dispatch / Rock Island Argus*
- Vulnerability: Outdoors in a tent under a tree, sleeping, no sirens were sounded. Highest gust: 94 at MLI (Would be EF1 on EF Scale)

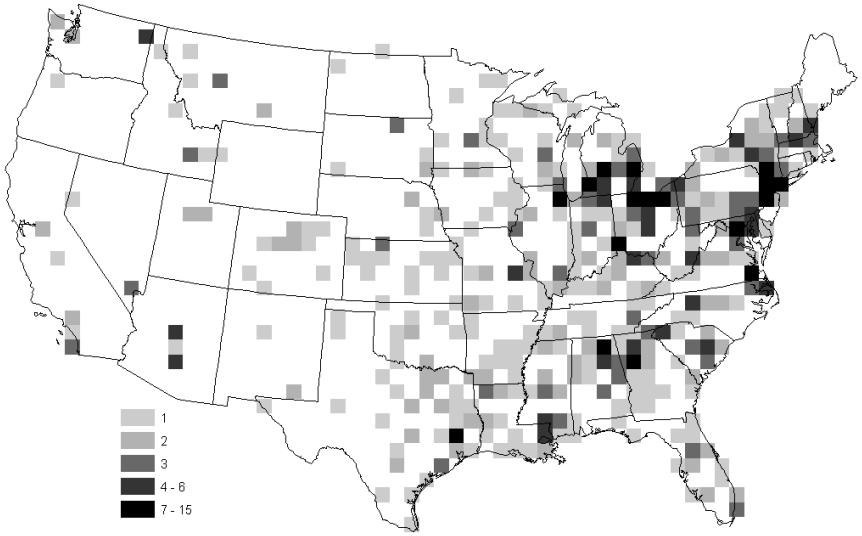
Killer tornado locations in a 80km x 80km grid, 1977-2007.

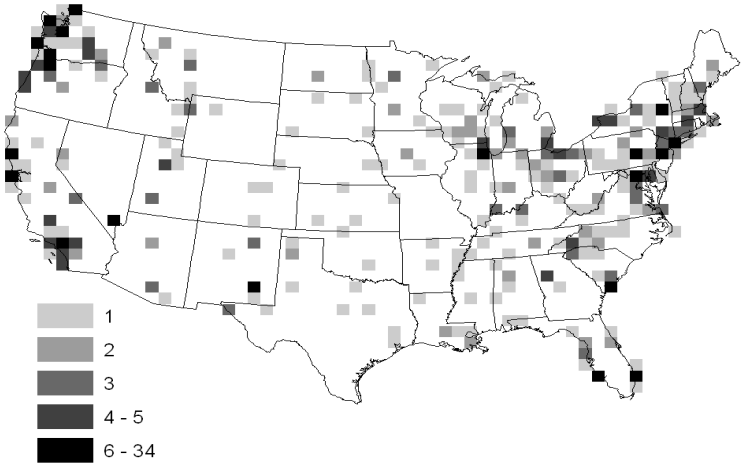


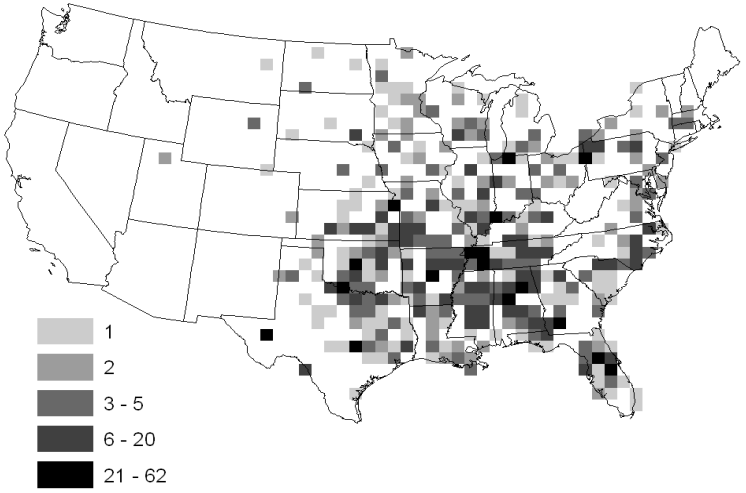
Nonconvective wind fatality locations in an 80km x 80km grid 1977-2007.



Fatalities by Location - Comparison







Above: Nontornadic convective fatality locations, 1977-2007.
Top right: Nonconvective wind fatalities by location, 1977-2007.
Bottom right: Tornado fatalities by location, 1977-2007.

Conclusions

- Nontornadic convective wind is a significant killer.
  - 1195 fatalities between 1977-2007.
- No discernable year-to-year trend in fatalities.
- Most fatalities occur in Spring (May, June, July) and between the hours of 1400 and 1600 CST, corresponding with the climatological maximum of thunderstorms.

Conclusions

- Most fatalities occur in aircraft, outdoors, in vehicles, and while boating.
  - Compare to tornado fatalities, where most fatalities occur in mobile homes or permanent homes
  - Lack of public perception of the threat?
- Unique fatality distribution
  - Great Lakes, Northeast, parts of the South.

Conclusions

- Only about 32% of nontornadic convective wind fatalities are attributable to derechos.
  - Other less organized windstorms are responsible for most fatalities.
  - This may increase difficulty of detection compared to tornadoes.

Recommendations

- A renewed focus on warnings and mitigation for nontornadic convective wind.
- Improvements in communication of warnings to the public.
- Assessment of public perception of hazardous weather.
- Improvement in the collection of information on casualties and damage caused by hazardous weather.

Recommendations

- Stakeholders should consider their siren plan for severe wind.
  - Is a thunderstorm producing high winds any less dangerous than a tornado, especially for those outdoors?
  - In the aftermath of the July 21, 2008 storm, QC Metro Area cities/counties agreed to sound sirens for thunderstorms with winds of 70mph or golf ball sized hail.
  - Severe Thunderstorm Warnings have the maximum hail size and wind speed expected appended (at least for now).
    - LAT...LON 3882 9418 3857 9414 3859 9458 3868 9460
      TIME...MOT...LOC 1556Z 259DEG 31KT 3866 9451
      WIND...HAIL 70MPH 2.75IN

Thank You!

Questions?